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Acoustical Performance of Noise Barriers

Hwy. 417, North Side
Pinecrest Avenue to Richmond Road
in the Cities of Ottawa and Nepean

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Abstract:
This report is one of a series of reports which evaluate the acoustical performance of highway noise barriers constructed by the Ministry of Transportation and Communications (MTC) in Ottawa. The noise barrier evaluated herein is situated on the north side of the Ottawa Queensway (Highway 417) between Pinecrest Avenue and Richmond Road. It was erected during the summer of 1983.

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1/ INTRODUCTION

This report is one of a series of reports which evaluate the acoustical performance of highway noise barriers constructed by the Ministry of Transportation and Communications (MTC) in Ottawa, along Highway 417 [1, 2]. The noise barrier evaluated herein is situated on the north side of the Ottawa Queensway (Highway 417) between Pinecrest Avenue and Richmond Road. The noise barrier was erected during the summer of 1983. Figure 1 shows the general setting of the site as well as the alignment of the noise barrier and the location of the measurement points.

2/ MEASUREMENT OF BARRIER INSERTION LOSS

Sound level measurements were obtained at six locations behind the barrier and were located as shown in Figure 1. The methodology used to obtain the measured barrier insertion losses is briefly outlined below.

Before-construction sound level measurements at each observation point were obtained by stationing one sound level measurement system at the control measurement location and another at a site location and operating them simultaneously. The sound level measurements at the sites were all performed with a microphone height of 1.2 m above ground. The control sound level measurements were performed with a height of 6.1 m above ground. All measurements were of a 20-minute duration (with the single exception being the long-term measurements which averaged approximately four hours in duration).

The after-construction sound level measurements were conducted using the same procedure, with all measurement systems placed at the same locations as those used in the before-construction surveys.

The barrier attenuation, adjusted for variations in highway traffic, was determined at each observation point using the following expression:

Barrier insertion loss in dB(A)at location i = $(L_{AC} - L_{Ai}) - (L_{BC} - L_{Bi})$
where:

L_{AC} = after-construction sound level measured at the control measurement location, in dB(A).

L_{Ai} = after-construction sound level measured at location i, in dB(A).

L_{BC} = before-construction sound level measured at the control measurement location, in dB(A).

L_{Bi} = before-construction sound level measured at location i, in dB(A).

All measurements are L_{eq} values for the 20-minute time period.

The measured sound levels and insertion losses are presented in Table A1 and A2 of the Appendix. Standard MTC instrumentation was used to perform the measurements.

3/ COMPARISON OF MEASURED AND PREDICTED SOUND LEVELS

Before- and after-barrier-construction measured and predicted sound levels were compared in order to evaluate the accuracy of the US Federal Highway Administrations computer prediction method entitled STAMINA 2.0/OPTIMA [3]. This model has been modified by MTC [4] and is currently being used to prepare acoustical design advice for the construction of noise barriers.

The predicted sound levels were calculated by using traffic volumes derived by dividing the 1982 AADT by 24. The difference between the before- and after-construction sound levels, adjusted by the use of a control measurement, represent the reduction in sound levels due to barrier construction. These sound levels are shown in Table 1.

In general, there was a very good agreement between the measured and predicted sound levels. The typical barrier insertion loss measured at locations not shielded by houses was about 5 dBA, which is approximately the level which was predicted.

A long-term measurement series based on ambient sound level measurements was carried out at a more distant location from the highway (about 70 m from centreline). At this location a reduction in sound levels of approximately 2 dBA was recorded. These measurements do not take into account slight variations in the sound being emitted from the road traffic, but they are based on measurements conducted over a longer duration (approximately four hours for each sound level measurement period).

4/ CONCLUSIONS

1/ The average measured and predicted insertion loss in backyards unshielded by rows of houses was approximately 5 dBA.

2/ The good agreement obtained between the measured and predicted sound levels tends to verify the applicability of the computer prediction procedure based on STAMINA 2.0.

5/ REFERENCES

[1] Krawczynuik, R.W., and Hajek, J.J., "Acoustical Performance of Noise Barriers, Highway 417, North and South Sides, West of Woodroffe Avenue, Ottawa," Report AE-83-02, Research and Development Branch, Ministry of Transportation and Communications, Ontario, March 1982.

[2] Hajek, J.J., "Noise Barrier Attenuation, Highway 417, North Side, East of Island Park Drive, Ottawa," Report AE-81-05, Research and Development Branch, Ministry of Transportation and Communications, Ontario, April 1981.

[3] Bowlby et al, (Edit.), "Noise Barrier Cost Reduction Procedure STAMINA 2.0/OPTIMA: User's Manual," US Federal Highway Administration, Report FHWA-DP-58-1, April 1982.

[4] Krawczynuik, R.W., and Hajek, J.J., "Guidelines for Noise Barrier Cost Reduction Procedure, STAMINA 2.0/OPTIMA," Report AE-83-01, Research and Development Branch, Ministry of Transportation and Communications, Ontario, May 1983.

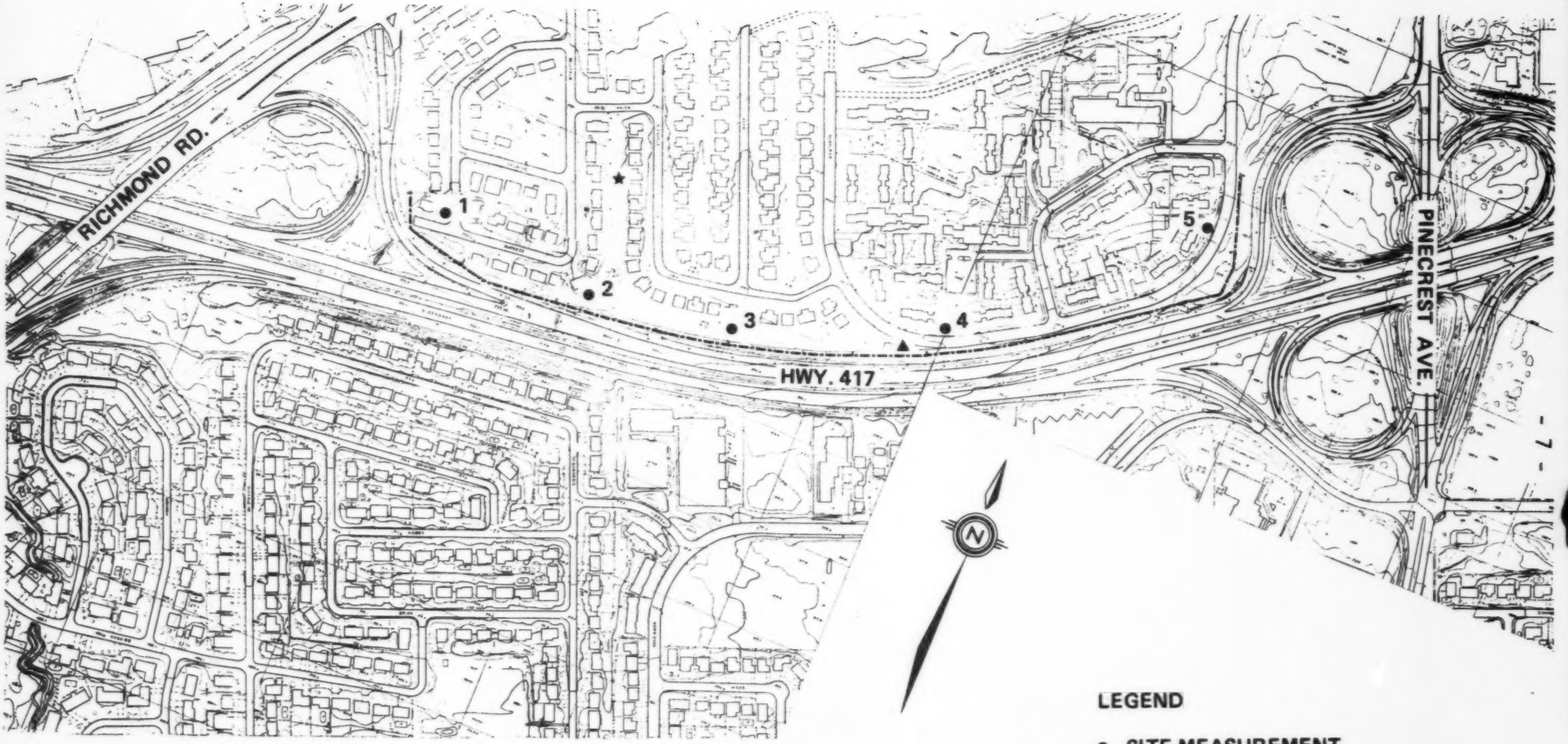

Figure 1/ General Barrier Setting with Measurement Locations

Table 1/ Comparison of Measured and Predicted Sound Levels

	Sound Levels Before Construction L_{eq}, dBA		Barrier Insertion Loss ΔL_{eq}, dBA	
Measurement Location[1]	Measured[2]	Predicted	Measured[3]	Predicted
1	2	3	4	5
Part A: Locations Not Shielded by Houses				
1	60.0	62.8	5.7	4.8
2	65.5	69.6	7.7	8.3
3	60.4	65.4	3.6	2.6
4	66.7	67.5	5.8	4.0
5	61.0	63.8	1.0	3.2
Average	62.7	65.8	4.8	4.6
Part B: Long-term Measurement Location				
	53.5	54.8	2.0	2.3
Part C: Control Measurement Location				
	70.5	70.6		

Notes:

[1] Measurement locations are shown in Figure 1. All measurements were taken 1.2 m above ground.

[2] The sound levels were obtained by averaging the measured sound levels (Table A1, Column 5) at each location before construction.

[3] The measured insertion losses were taken from Table A1, Column 8 and have been adjusted for traffic variation using control measurements.

Appendix/ Measured Sound Levels

Table A1, Measured Sound Levels, L_{eq}

Location[1] Number			L_{eq}			Measured Insertion Loss	
	Date	Time[2]	Control Meas.	Site[3] Meas.	Difference 4-5	ΔL_{eq}[4]	Average ΔL_{eq}[5]
1	2	3	4	5	6	7	8
1B[6]	82-07-08	13:25	71.0	61	10.0		
1B	82-07-14	12:07	71.0	58.7	12.3		
1A	83-08-09	12:10	70.7	54.3	16.4	5.2	
1A	83-08-10	12:20	70.8	53.5	17.3	6.1	5.7
2B	82-07-08	13:55	70.8	66	4.8		
2B	82-07-13	13:20	70.5	65	5.5		
2A	83-08-10	11:55	71.1	56.8	14.3	9.1	
2A	83-08-11	10:38	71.4	59.9	11.5	6.3	7.7
3B	82-07-13	12:25	71.5	60	11.5		
3B	82-07-13	12:45	70.1	61	9.1		
3B	82-07-14	10:55	70.4	60.1	10.3		
3A	83-08-09	10:45	71.4	58.0	13.4	3.1	
3A	83-08-10	11:20	72.0	57.7	14.3	4.0	3.6
4B	82-07-08	14:25	69.1	66	3.1		
4B	82-07-14	10:55	70.4	67	3.4		
4B	82-07-14	11:35	70.8	67	3.8		
4A	83-08-09	10:45	71.1	60.8	10.3	6.9	
4A	83-08-10	11:55	71.3	61.8	9.5	6.1	
4A	83-08-11	11:30	71.5	63.6	7.9	4.5	5.8
5B	82-07-08	11:40	69.7	61	8.7		
5A	83-08-11	11:30	71.5	61.8	9.7	1.0	1.0

Notes:

[1] Measurement locations are shown in Figure 1.

[2] Starting time of measurement. All measurements were of a 20-minute duration.

[3] The measured sound levels were unadjusted for road traffic and other variations.

[4] The barrier insertion losses were adjusted for traffic and other variations using control measurements. The barrier insertion losses at each location were obtained by subtracting the average of the results given in Column 6 for the before series (B) from the results given in Column 6 for the after series (A).

[5] The average barrier insertion losses were calculated from Column 7.

[6] Measurements taken:
B -- Before barrier was constructed.
A -- After barrier was constructed.

Table A2/ Measured Sound Levels at the Long-Term Measurement Locations

Date	Time[1]	Duration in Hours	Site[2] Measured Sound	Average[3] Sound Level	Δ Difference[4] in Sound Level
Before Construction					
82-07-08	11:30	3.5	53.9		
82-07-13	12:00	2.0	52.5	53.2	
After Construction of Barrier					
83-08-09	11:00	4.5	53.6		
83-08-10	11:30	5.0	48.9		
83-08-11	10:30	4.0	51.0	51.2	2.0

Notes:

[1] Starting time of measurement.

[2] Measured ambient sound level in dBA (L_{eq}) which are unadjusted for variation in road traffic.

[3] An average of the measured ambient sound levels.

[4] Before-construction ambient sound levels minus after-construction ambient sound levels.